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## **A continental perspective on the timing of the last glacial maximum in Australia - utilising methods for integrating multiple time-uncertain, variable resolution proxy records.**

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Many palaeoclimate and palaeoenvironmental records have low sampling resolution, few age constraints, and are based on climate proxies that may reflect an uncertain mixture of local and regional influences. Objective spatial and temporal comparisons of multiple palaeo records and identification of regional scale trends can therefore be difficult. Low resolution palaeo records are often excluded from regional syntheses due to low dating or sample density, however such records can contribute meaningful information to regional syntheses if their inherent uncertainties are considered. Explicitly incorporating the age uncertainties allows for a more robust interpretation of synchronous periods of change.

Here we discuss the use of a method for determining the timing of palaeoclimate events using multiple time-uncertain palaeo records. This method allows for the incorporation of a variety of records, regardless of proxy type or sampling resolution. We demonstrate the power of this method using a case study from the SHeMax project (Southern Hemisphere Last Glacial Maximum project), aiming to understanding the nature and timing of the LGM in Australia. Further expansion of our analyses will allow the incorporation of both continuous and discontinuous climate archives, interrogation of spatial and temporal synchronicity and coherency of climate changes across broad regions.

An extended LGM period, characterised by multiple distinct stages that varied regionally and in its timing and evolution, has been suggested to have occurred in Australia; however this hypothesis has yet to be tested objectively. Comparisons during this time period have been hampered by the limited number, low resolution, and age-uncertainty of terrestrial archives. In order to gain a greater understanding of the spatial and temporal patterns of climate change during MIS2, we have compiled all available proxy records of climate and environmental variability from across

Australia for the period 35 – 15 ka (n=40). Analysing age-uncertainty in time series requires an approach that treats all data consistently. For each record, a revised age-depth model was developed using the SH13 calibration curve and Bayesian age-depth modelling techniques. Complex records (e.g. pollen records) were reduced to Principal Curves, in order to provide a one-dimensional summary of patterns of change in each data-set. Monte-Carlo change point analysis was then used to identify the timing of major changes within each record, along with the uncertainty around each change point. We assess the spatial heterogeneity of the timing of the major climatic changes during the 35 – 15 ka period and determine the probability of common timing of change across Australia. We find the onset of an extended period of relative aridity in Australia occurred synchronously (within uncertainty) at ca. 28 ka. Dry and cool conditions persisted at most sites until ca. 15 – 18 ka, with the onset of more humid conditions occurring along a latitudinal gradient. The occurrence of a millennial scale episode of increased moisture balance between ca. 25 – 21 ka is evident only in the most highly resolved records.